
Aristotle's Stoichiology: its rejection and revivals

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Abstract

Aristotle's rejection and reconstruction of the Pythagorean mathematization of things, of the Democritean and Platonic atomism, and the "materialism" of the pre-Aristotelian cosmologies, in general, are mostly based on his strikingly original theory of stoichiological opposites (ἔναντιὰ στοιχεῖα), that is, the basic triadic set of principles, which, though ontologically distinct, are, intimately related. The theory involves: (a) the subject-in-process, which is continuous throughout the process of change or the substrate matter or the potentially perceptible body, (b) the four perceptible contraries, hot, cold, wet, and dry, which form the prime pair of contraries of the chemical elements, and (c) the four primary, actually perceptible bodies, fire, air, water and earth, which are subject to destruction and generation, also designated by the terms: "the first bodies" (τὰ πρῶτα σώματα), "the simple bodies" (τὰ ἀπλά σώματα), and which are distinguished from the traditional, the "so-called elements" (τὰ καλούμενα στοιχεῖα).

Basic to the understanding of the triadic in character of Aristotle's stoichiology, is to have a satisfactory review of the positions held by his predecessors, and Aristotle's own theory - its "adequate and comprehensive formulation" - taking into account the fact of change which entails a contradiction, the contradiction which involves qualitative change from one quality to a contrary quality, the alteration which implies some substratum underlying the change, which, in turn, though cannot in itself be two contraries, is equally necessary to be understood as principle (ἀρχή), as source of change.²

Concerning our first point, it can be said that, in spite of Aristotle's limited views on chemistry and on his empirical method, his critical analysis of previous cosmologists was both advantageous and provocative. He divides his predecessors into those who assume that the underlying matter (τὴν ὑποκειμένην ὕλην) is corporeal (σῶμα) and separable (χωριστόν), whether they claim that the element is one (monists) or more than one (pluralists). One of these (probably Anaximander), postulated a single "unqualified", "infinite" or "undifferentiated" (ἄπειρον) matter alongside the above mentioned bodies. The merit he finds in these cosmologists is that they rightly ranked the primary material bodies as "principles and elements" (ἀρχὰς καὶ στοιχεῖα).³

To Aristotle, all the pre-Aristotelian cosmologists rightly claim that the matter, the contraries and the elements are principles (ἄρχάς, 329a 6), that "all beings and all substance" are composed of contraries, that all speak of the "first principles as contraries" - some as Odd and Even (Pythagoreans), some as Hot and Cold (Anaxagoras- Parmenides?), some as Limited and Unlimited (Platonists), some as Love and Strife (Empedocles) - and all other things are reducible to Unity and Plurality (ἀναγόμενα φαίνεται εἰς τὸ ἕν καὶ τὸ πλῆθος) .⁴ But this is, for Aristotle, a materialistic approach of the nature of things, for they make one of the two contradictions matter: the unequal matter for the equal (The Pythagorians), the many matter for the one (The Platonists) or identified the elements with the matter of change, while themselves remaining constant throughout change (The Atomists). Plato's receptacle (πανδέχης), however, is seen as a substrate prior to the so-called elements (ὑποκείμενόν τι τοῖς κκαλουμένοις στοιχείοις πρότερον, 329a 16).⁵

In contrast (i) to those who postulate a corporeal and separable matter devoid of perceptible contradictions and (ii) to Plato who, although recognises a substratum underlying the elements, has not clearly stated whether it exists in separation from the elements, Aristotle's theory of elements or stoichiology claims (i) that there is a matter of the perceptible bodies from which the so-called elements come to be, that it has no separate existence, but it is always bound up with a contrariety, and (ii) that has given a more precise account in another work.⁶

In the Aristotelian stoichiology, the elements, as the final points of analysis and as chemical abstractions, are neither identical with the substratum, the subject-in- process, nor completely separated from the prime contraries of the given substances. According to Stagirite, the four elements, earth, water, air, fire, and such things that people have been calling "elements", as perceptible bodies or as sensible individual substances (minerals, plants, animals, and human beings), are principles and always subject to process or change (μεταβολή), with respect to the four types (substance, quality, quantity, place), and, consequently, subject to generation and destruction. An element, according to Aristotle's definition, is "a body into which other bodies may be analyzed, present in them potentiality and actuality, and not itself divisible into bodies different in form (αὐτό δ' ἔστιν ἄδιαιρέτον εἰς ἕτερα τῶ εἶδει). That, or something like it, is what all men in every case mean by element"⁷.

The principles of perceptible bodies presuppose the other two principles: that of matter which, as potentially perceptible body, is inseparable from the perceptible bodies, but always underlying the contradictions, thus being an ultimate principle, as it is evident from the fact that hot is not matter for the

cold nor the cold for the hot, but is the underlying substrate for both of them (ὑποκείμενον ἀμφοῖν, 329a 33), and that of contradictions as for example heat and cold.

The status and functions of these principles determine their rank in priorities, and, consequently, their ontological adequacy and coherence in contrast to the inadequacy and incoherence of the predecessors. Thus, the substrate matter, though it is inseparable from the contrary qualities (the hot and the cold) and is recognized as the potentially perceptible body, is the first originate source and enjoys the first primacy. The second originate source is the perceptible contrary qualities (heat and cold), which cause the perceptibility of bodies. While one contrary quality cannot be matter for another, the substratum is matter for both. The third set of principles of perceptible bodies is the combination of the potentially perceptible body and the perceptible. The contrary qualities are posterior to them, because the perceptible bodies, the four elements, can change into one another, while the contrary qualities themselves remain unchanging (329a 35-b3: μεαβάλλει εἰς ἄλληλα, αἱ δ' ἐναντιώσεις οὐ μεαβάλλουσιν). In other words, the perceptible contraries, as contraries themselves, which do not suffer change, stand between the substrate matter, in which all processes take place by means of a subject (ὑποκείμενον), the subject-in-process or, as J. P. Anton calls it, "a unit of distributive being that is in process, undergoes changes, develops, and actualizes its inherent 'end'",⁸ and that which is the generation and individuation, that is, the outcome of the union of the form with the substratum.⁹

For Aristotle, no pair of contraries is in itself sufficient to account for the understanding of any substance or process whatsoever, for the simple reason that the latter does not, in itself, constitute substance or a process. To complete the theory, Aristotle had to (a) raise the prime pair of contraries (τὰ πρῶτα) to the stature of principles, which, although they do not involve each other or anything in their composition, they are involved in the composition of everything else (μήτε ἐξ ἀλλήλων εἶναι μήτε ἐξ ἄλλων),¹⁰ and (b) to elevate the substratum underlying the perceptible contraries to a primary principle.

Thus far, the advance made by Aristotle's theory is an ontological one, in that there are three principles involved in his analysis: the substratum or the subject-in-process, the two prime opposites, and perceptible bodies. Aristotle's own use of privation, for example, is a contrary to form in a given substance, thus being the basis for his own triadic model of the basic category of substance. All the pre-Aristotelians, on the contrary, speak of the first principles as opposites (contraries). Against the Atomists, Aristotle introduced

hyle as a principle of change, which underlies the four elements. Aristotle's prime matter can be compared to the unity that underlies sensible change in all pre-Aristotelian conceptions of the atoms, the *apeiron*, fire or logos, and so on.

For Aristotle, things that exist by nature exhibit, besides the internal nature¹¹, the four simple elements, that is, fire, earth, water, and air, which are defined in terms of the prime matter along with the four positive or negative opposite qualities, and the relation they have to each other. They all form the basic qualitative pairs of opposites, namely, hot, cold, wet, and dry. This is the fundamental doctrine of contraries as set out in Aristotelian physics.

The importance of the theory lies in the fact that we are able to obtain valid empirical knowledge through its logical relation to its opposite "negative form" or the "form by privation". The theory is illustrated clearly in the case of change. Change is possible not only because of the positive forms, but also because of the forms by negation or privation. This means not only that any change into contraries implies some matter (substratum) underlying the change (something undergoing the change), but also the substratum, which is contrary to nothing, underlies any pair of contraries, and, consequently, the contraries cannot be reduced to or identified with the substratum. Thus, both a substratum and contraries are necessary as ἀρχαί, principles, sources, of change.¹³

Another important consequence of the theory is that it makes apparent the interplay of potentiality and actuality. For a thing to be actualised and be in the state of becoming, change and novelty, involves its opposite qualities which subsist as mere potentialities which, in turn, become actualised. This new pair of contraries of potentiality and actuality, where the unity that underlies change is not most real, but least real, has led to the abandonment of the opposition between appearance and reality and to the reversal of the order of reality: what was the "appearance" now becomes the reality. The outcome of the theory is that both real and possible are preserved in their movement to the four levels of distributive being and their syntheses: the simple bodies, the inanimate compounds, the parts of animals and their parts, up to whole organic level of animal and human complexities.¹⁴ Stated differently, "for anything to be, is not merely to possess certain sensed properties, but also to have logically within itself the potentiality of becoming something else",¹⁵

In the light of the Aristotelian theory, one can easily see its multifarious alternatives to past "materialistic" theories such as monism or pseudo-monism with the unchangeable (e.g. Parmenides and Melissus), and the changeable "one" (Thales and Anaximenes and Heraclitus); of dualism (Pythagoreans); of

triadic materialism (Plato), of tetradic materialism (Empedocles), and of the infinite types of materialism (Anaxagoras, Atomists). Aristotle's elastic and diplomatic theory for the generation of elements, avoids the traps of the above mentioned "materialists", because the so-called elements, come into being as substances (οὐσίαι), pertain to substratum (ὑλῆ), capacity to be, along with its coexistence with the requisite for change contraries¹⁶. It also avoids the dilemma of the elements being incorporeal or corporeal. It cannot be the former, for every natural being is corporeal and must, therefore, come from some body, simple or compound; it cannot be the latter either, for, if it is compound it will itself be constituted of elements, and if it is simple it must itself be an element. It remains the alternative that the elements are generated by changing into each other¹⁷, as they are related to individual substances, to the whole field of the continuous prime matter and the prime metaphysical contraries, or the First Philosophy as far as it concerns itself with individual substances in linear process. This is, undoubtedly, due to the consistency of the theory with Aristotle's metaphysics of "distributive being"¹⁸, to its wide application, and, above all to the new and comprehensive approach to the nature of things. Basic to the understanding of the theory is its triadic structure, that is, the formal demand for an intelligible knowledge of all beings in process, the substratum, and the prime metaphysical pair of contraries or principles (ἄρχαί). Without this structured theory of stoichiology the refutation and the reconstruction of the pre-Socratic cosmologies would be impossible. The same is true for the reconstruction of sciences related to it.

Thus, Aristotle, armed with the most original and widest in its application concept of substratum and the pair of contraries "form and privation", "potentiality" - "continuity" and "actuality", was able to hold, without contradicting himself and without falling into the paradox of Zeno or the labyrinth of Leibniz, both the immediately apprehended manifold of matter provided through the senses and through the elementary constituents of "secondary matter", that is, the qualitatively differentiated prime matter, "the positive form" and the logical relation to their opposites, the "negative form"¹⁹.

Negatively stated, Aristotle's theory was able to avoid not only reducing contrariety to substratum or identifying the elements with the substratum, but also conceiving the elements as unchanging. Hence, the inevitable conclusion: "There must be something which is continuous through out the process of change", and "there must the elements of bodies be subject to destruction and generation."

No doubt, Pre-Socratic cosmologists, Socrates and Plato, though for different reasons, made use of the theory of elements, its principles and contrarities to solve their cosmological and ontological problems. But it was

Aristotle, above all, who attempted a systematic formulation, analysis and solution of the problems involved. Professor J. Anton, speaking about contraries, states that Aristotle's "carefully formulated theory of contrariety is undeniably present in all his works and constitutes an integral part of his metaphysical thought"²⁰.

By applying the interplay of contraries to every scale of existence and to all spheres of knowledge - save only the ether, pure actuality, *Nous*, heavenly bodies and their intelligences - Aristotle could give a full account for triadic relation of the elements, along with an empirically grounded qualitative differentiation, its description and its scientific classification. The contraries of the mathematical sciences (geometry and arithmetic), on the one hand, and those of physics, on the other hand, are paradigmatic cases, in that they provide a satisfactory account for the limited and the unlimited, as well as for the corresponding qualitative differentiation.

Endnotes

1. Cf. Leclerc, I. 1972. *The Nature of Physical Existence*. London, Georg Allen & Unwin. p. 136; *De caelo*. 305a 13-14: "ὥστ ἀνάγκη φθαρτά καί γενητὰ εἶναι τὰ στοιχεῖα τῶν σωμάτων", and also Halm, D.E. 1993. *Aristotle on the Principles of Perceptible Body*. SAGP, April 1993, p. 1 and 2.
2. Cf. *De gen. et corr.*, Bk II, Chapters 1 and 2. The undertaking, however, is enormous for it is applicable to all possible branches of empirical knowledge and scientific inquiry. It includes sciences such as those of mathematics and of physics, of biology and of psychology, etc., the culmination, the "τέλος", of which would be the transformation of cosmology into and the formation of a complete ontology. On account of this, the presentation, analysis and evaluation of such an undertaking is beyond the purpose of this inquiry. Therefore, we shall limit ourselves to reviewing his criticism of the preceding cosmologists to the presentation of his own stoichiology (στοιχειολογία), to relating it to the theory of contrariety and to the mathematical and physical sciences. Questions concerning the fifth element, the ether or the science of being *qua* being and eternal being, which is both changeless and unmoved, as belonging to the highest type of being (περί τῶ τιμιώτατον), will be excluded from our investigation.
3. Cf. *De gen. et corr.*, 329a 5-8. But they are wrong in so far as they consider any body as existing without some perceptible contrariety. In Aristotle's theory any body cannot be completely undifferentiated. It has to be a contrariety, hot or cold, wet or dry.
4. Cf. *Met.* 1004b 30-35.

5. Cf. *Tim.* 48b51b, 50a-c. Though it comes closer than anyone else to conceiving the substrate matter as the first principle of perceptible body, he failed in its exact definition (ἄλλοίωσις) and in speaking clearly (σαφῶς: 329a 14) about it, as it is evident from the analogy he uses of the gold from which a golden object is made (329a 17-21), and from the triangular plane surfaces he introduces (329a 21-23). In the first case, Plato does not adequately differentiate the receptacle from the elements, while the analogy of gold metal he uses is confusing to say the least, because it applies to phenomenon of alteration (ἀλλοίωσις), but not to phenomena of generation and destruction (γένεσις καὶ φθορά: 329a 19). The same criticism applies to his reduction of the solid elements into plane surfaces, for it is impossible for the latter (τά ἐπίπεδα) be "the first matter", (τὴν πρώτην ὕλην: 329a 24). Thus Plato, though he correctly conceived of the substrate matter as underlying every elemental change, has used an inappropriate analogy, an inadequate definition and inconsistent application for the explanation of genesis and destruction.

6. Cf. *Gen. et Corr.*, 329a 24-28: "Ἡμεῖς δὲ φαμέν μένειναι τινα ὕλην τῶν σωμάτων τῶν αἰσθητῶν, ἀλλὰ ταύτην οὐ χωριστὴν ἀλλ' αἰεὶ μετ' ἐναντιώσεως, ἐξ ἧς γίνεται τὰ καλούμενα στοιχεῖα. Διῶρισται δὲ περὶ αὐτῶν ἐν ἑτέροις ἀκριβέστερον". Cf. *Physics* i. 6-9.

7. *De caelo*, 302a 16-18.

8. *Op. cit.*, p.11.

9. Cf. *Met.*, 983b 5ff.

10. *Phys.*, 188a 27-28.

11. Cf. *Phys.*, 192b 13-14.

12. Cf. *Phys.*, Bk. I.

13. Cf. *Met.* 1075a 27-34; *De gen. et corr.*, Bk II, Chs 1 and 2.

14. Cf. Anton, J.P. *op. cit.*, pp. 22-23.

15. Cf. Northrop, F.S.C. *op. cit.*, p. 269.

16. Cf. *De gen. et corr.*, 320a 25-27: "τὴν ὕλην τῶν σωμάτων αἰσθητῶν... οὐ χωριστὴν ἀλλ' αἰεὶ μετ' ἐναντιώσεως, ἐξ ἧς γίνεται τὰ καλούμενα στοιχεῖα."

17. Cf. *De caelo* 305b 28: "λείπεται δ' εἰς ἄλληλα μεταβάλλοντα: γίνεσθαι." Cf. Leclerc, I. *op. cit.* p. 138.

18. Anton, J.P. 1987. *Aristotle's Theory of Contrariety*. University Press of America, 1987, pp. 14ff. This work is basic for understanding Aristotle's use of the terms and their meaning such as opposite, subject-in-process,

substance, principle and contrariety. Privation, together with the subject and the form or essence, are the three factors that are required in any change that occurs in a subject, a subject-in-process, since "πάντα τὰ γιγνόμενα ἐξ ὑποκειμένων γίνονται." Phys., 190b 9-10. Subject-in-process is something different from the contraries, for it itself is not a term of a contrariety "ἄλλο εἶναι τὸ ὑποκείμενον τοῦτο γὰρ οὐκ ἐναντίον." Phys. 190b 33-34. Generally speaking, substance is an ontological principle, and contrariety a principle of the process of understanding. But the principles involved in the process are either two (matter and form) or three (the subject - in process and the two polar extremities of the metaphysical contrariety).

19. Cf. Northrop, F.S.C. 1968. Meeting of East and West, *The Macmillan Co., New York*. pp.26~67.

20. Anton, J.P. 1987. *Aristotle's Theory of Contrariety*. American University Press, p. 6.